IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

KIMATA et al. Atty. Ref.: 2635-22; Confirmation No. 4404

Appl. No. 09/885,023 TC/A.U. 2855

Filed: June 21, 2001 Examiner: M. Cygan

For: GAS SENSOR

* * * * * * * * * * * *

February 25, 2004

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AMENDMENT

In response to the Office Action dated October 10, 2003, please amend the above-identified application as follows:

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A gas sensor comprising a cylindrical insulator having an element insertion hole extending from a proximal end to a distal end thereof, a gas sensing element airtightly fixed in said element insertion hole of the insulator, and a cylindrical housing having an inside space for placing said insulator, with an air side cover attached to a proximal end of said housing so as to confine an aerial atmosphere

therein and a measured gas side cover attached to a distal end of said housing so as to confine a measured gas atmosphere therein, wherein

a sealing material is provided within the cylindrical insulator at said proximal end of said element insertion hole for sealing a clearance between an inner surface of said element insertion hole and an outer surface of said gas sensing element, and

a cushion filler is spaced apart from said sealing material ~~provided~~ at said distal end of said element insertion hole for sealing a clearance between an inner surface of said element insertion hole and the outer surface of said gas sensing element.

2. (Previously Presented) The gas sensor in accordance with claim 1, wherein a filling percentage of said cushion filler provided between said inner surface of said element insertion hole and the outer surface of said gas sensing element is in the range from 10% to 80%.

3. (Original) The gas sensor in accordance with claim 1, wherein an injection port is provided near an open edge of said element insertion hole at the distal end of said insulator for facilitating a filling operation of said sealing material or said cushion filler.

4. (Original) The gas sensor in accordance with claim 1, wherein said element insertion hole comprises a large-diameter portion and a smaller-diameter portion, and an inner diameter of said larger-diameter portion is larger than that of said smaller-diameter portion.

5. (Original) The gas sensor in accordance with claim 1, wherein said sealing material and/or said cushion filler is placed so as to fix at least two opposed surfaces of the inner surface of said element insertion hole and the outer surface of said gas sensing element.

6. (Currently Amended) A gas sensor comprising a cylindrical insulator having an element insertion hole extending from a proximal end to a distal end thereof, a gas sensing element airtightly fixed in said element insertion hole of the insulator, and a cylindrical housing having an inside space for placing said insulator, with an air side cover attached to a proximal end of said housing so as to confine an aerial atmosphere therein and a measured gas side cover attached to a distal end of said housing so as to confine a measured gas atmosphere therein, wherein

a sealing material is provided within the cylindrical insulator at said proximal end of said element insertion hole for sealing a clearance between an inner surface of said element insertion hole and an outer surface of said gas sensing element,

a cushion filler is spaced apart from said sealing material ~~provided at~~ said distal end of said element insertion hole for sealing a clearance between an inner surface of said element insertion hole and the outer surface of said gas sensing element,

said insulator constitutes a main body and a separate body attached via a spacer to a distal end of said main body, so that said element insertion hole extends across both of said main body and said separate body, and

said cushion filler is provided only in the element insertion hole of said separate body.

7. (Previously Presented) A gas sensor as claimed in claim 1, said cushion filler being capable of withstanding a loading force from 5N to 1,000N.

8. (Previously Presented) A gas sensor as claimed in claim 6, said cushion filler being capable of withstanding a loading force from 5N to 1,000N.

9. (Currently Amended) A gas sensor comprising:

a cylindrical insulator having an element insertion hole extending through its central region;

a gas sensing element disposed within the element insertion hole and being securely fixed at two spaced apart points of said element insertion hole within ~~to~~ opposite ends of said cylindrical insulator to prevent said gas sensing element from swinging within said cylindrical insulator; and

a cylindrical housing having an inside space for receiving said cylindrical insulator and said gas sensing element, with an air side cover attached to a proximal end of said housing so as to confine an aerial atmosphere therein and a measured gas side cover attached to a distal end of said housing so as to confine a measured gas atmosphere therein.

10. (Currently Amended) A gas sensor as claimed in claim 9, further including a sealing material provided at one of said two spaced apart points ~~end~~ of said element insertion hole for securely fixing said gas sensing element to said cylindrical insulator and for sealing a clearance between an inner surface of said element insertion hole and an outer surface of said gas sensing element.

11. (Currently Amended) A gas sensor as claimed in claim 10, further including a cushion filler provided at the other end of said two spaced apart points ~~an end opposite to said one end~~ of said element insertion hole for securely fixing said gas sensing element to said cylindrical insulator and for sealing a clearance between an inner surface of said element insertion hole and the outer surface of said gas sensing element.

12. (Previously Presented) A gas sensor as claimed in claim 11, wherein a filling percentage of said cushion filler provided between said inner surface of said element insertion hole and the outer surface of said gas sensing element is in the range from 10% to 80%.

13. (Previously Presented) The gas sensor in accordance with claim 11, wherein an injection port is provided near an open edge of said element insertion hole at the distal end of said insulator for facilitating a filling operation of said sealing material or said cushion filler.

14. (Previously Presented) The gas sensor in accordance with claim 9, wherein said element insertion hole comprises a large-diameter portion and a smaller-diameter portion, and an inner diameter of said larger-diameter portion is larger than that of said smaller-diameter portion.

15. (Currently Amended) A gas sensor comprising:

a cylindrical insulator having an element insertion hole extending through its central region;

a gas sensing element disposed within the element insertion hole and being securely fixed at two spaced apart points of said element insertion hole within ~~to~~ opposite ends of said cylindrical insulator to prevent said gas sensing element from swinging within said cylindrical insulator;

a cylindrical housing having an inside space for receiving said cylindrical insulator and said gas sensing element, with an air side cover attached to a proximal end of said housing so as to confine an aerial atmosphere therein and a measured gas side cover attached to a distal end of said housing so as to confine a measured gas atmosphere therein; and

wherein said insulator constitutes a main body and a separate body attached via a spacer to a distal end of said main body, so that said element insertion hole extends across both of said main body and said separate body.

16. (Currently Amended) A gas sensor as claimed in claim 15, further including a sealing material provided at one of said two spaced apart points ~~end~~ of said element

insertion hole for securely fixing said gas sensing element to said cylindrical insulator and for sealing a clearance between an inner surface of said element insertion hole and an outer surface of said gas sensing element.

17. (Currently Amended) A gas sensor as claimed in claim 16, further including a cushion filler provided at the other of said two spaced apart points ~~an end opposite to said one end~~ of said element insertion hole for securely fixing said gas sensing element to said cylindrical insulator and for sealing a clearance between an inner surface of said element insertion hole and the outer surface of said gas sensing element.

18. (Currently Amended) A method for protecting a gas sensing element of a gas sensor assembly by fixedly securing said gas sensing element at two spaced apart points within opposite ends of a central bore hole disposed within a cylindrical insulator, thereby preventing said gas sensing element from swinging within said cylindrical insulator, after said gas sensing element and cylindrical insulator are assembled within a housing of the gas sensor assembly.

19. (Currently Amended) An improvement for a gas sensor having an elongated gas sensing element mounted within and extending through an elongated aperture of an insulating member, said elongated aperture having a first larger cross-section portion axially spaced from a second relatively smaller cross-section portion and wherein said gas sensing element is fixedly sealed in a gas-tight manner within said larger cross-

section portion using a sealing material disposed within said larger cross-section portion, said improvement comprising:

a cushion material, softer than said sealing material, being disposed spaced apart from said sealing material within said smaller cross-section portion of the aperture and between the insulating member and the gas sensing element.

20. (Currently Amended) A method for protecting a gas sensor having an elongated gas sensing element mounted within and extending through an elongated aperture of an insulating member, said elongated aperture having a first larger cross-section portion axially spaced from a second relatively smaller cross-section portion and wherein said gas sensing element is fixedly sealed in a gas-tight manner within said larger cross-section portion using a sealing material, disposed within said larger cross-section portion said method comprising:

providing a cushion material, softer than said sealing material and spaced apart from said sealing material, within said smaller cross-section portion of the aperture and between the insulating member and the gas sensing element.